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AN INVESTIGATION OF SOLAR ECLIPSE EFFECT ON THE SUBPOLAR STRATOSPHERE

J. S. Randhawa

Army Electronics Command
White Sands Missile Range, New Mexico

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By

J. S. Randhawa

Atmospheric Sciences Laboratory
US Army Electronics Command
White Sands Missile Range, New Mexico 88002

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13. ABSTRACT

An experiment to study the effect of partial solar eclipse on the stratosphere was performed at Poker Flat, Alaska (65°07'N, 147°28'W), where a partial solar eclipse occurred on 10 July 1972. Chemiluminescent ozonesondes were deployed by Arcas Meteorological rockets to an altitude of 50-55 km. After ejection the sensors descended via radar reflective parachutes and transmitted alternately ozone content and ambient temperature. Soundings were made during the week of the eclipse as well as during and immediately before and after it. Results obtained indicate that there was no significant effect due to eclipse on ozone concentration, temperature, and winds in the upper stratosphere of the subpolar region.

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CONTENTS

INTRODUCTION

When the earth's atmosphere is denied solar radiation during an eclipse of the sun, marked changes occur in its state, particularly in the ionosphere, where the effects can be studied by means of radio waves. At lower elevations, the absence of solar radiation also affects the mesosphere and upper stratosphere, where ozone concentration is increased due to the absence of photodissociation. The studies made during two total solar eclipses, one at Tartagal, Argentina (22°32'S, 63°50'W) [1] and the other at Wallops Island, Virginia (37°50'N, 75°29'W) [2] showed an increase in ozone concentration and a decrease in temperature respectively at and near the stratopause level.

The stratospheric circulation in the Northern Hemisphere has been shown to exhibit a strong diurnal response to solar heating in the 45-55 km altitude region [3, 4]. This diurnal tidal motion is characterized by wind variations of the order of 20 meters per second in a layer centered near the stratopause level. Rocket measurements indicate a well-developed meridional variation, with the circulation directed towards the equator during the evening and morning hours (2000 to 0800 local time) and away from the equator during the rest of the time [5].

An experiment to study solar eclipse effects upon ozone, temperature, and wind field in the upper stratosphere was performed at Poker Flat, Alaska (65°07'N, 147°28'W), where a partial solar eclipse occurred on 10 July 1972.

EXPERIMENT

The path of totality passed over northern Alaska and moved northeastward across Canada. The launch site was located nearly 300 km south of the totality path. The first contact at the launch site occurred at 0853 local time and the last contact was at 1107. The maximum occultation was at 0958 (92%). The sensors used in the study were chemiluminescent ozonesondes [6] which incorporated temperature-sensing bead thermistors on a time-sharing basis with ozone sensors. Arcas meteorological rockets were utilized to carry the sensors, parachutes, and transmitters to an altitude of 50-55 km. After ejection, the sensors descended via radar reflective parachutes (4.5 m diameter). The transmitted signals were pulse modulated and received by a meteorological ground receiver on a carrier frequency of 1680 MHz. A Nike-Hercules radar was used for tracking the parachutes and for determination of instrument altitude with time.

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The temperature-ozonesondes deployed in this study measured ozone concentration, temperature, and winds during the week of eclipse as well as before, during and after the partial eclipse day. The soundings made in this period resulted in five ozone, four temperature, and nine wind profiles. One ozone profile was obtained from an electrochemical ozonesonde (MAST type) [7] flown on a balloon. The actual timings of the various soundings are given in Table 1.

RESULTS AND DISCUSSION

The results derived from the various data which were obtained from the high altitude rocket soundings are summarized below. Five ozone profiles, two on 7 July, two on 10 July, and one on 11 July 1972, are shown in Figures 1 through 3. Temperatures are given in Figures 4 and 5. Wind data in component form are shown in Table 2.

OZONE

Ozone is a trace constituent of the upper atmosphere. Even at its maximum concentration, there are only six molecules for one million other air molecules. Despite its scarcity, ozone acts as a strong absorber for solar ultraviolet radiation (2000-3000A) and plays a dominant role in determining the characteristics of the mesosphere and stratosphere.

A great variety of photochemical processes takes place in the upper atmosphere; only those involving the various forms of oxygen are relatively important in determining the amount of ozone. These important reactions are:

$$O + O_2 + M \longrightarrow O_3 + M \qquad (1)$$

where M is any third atom or molecule.

$$O_2 + h\nu \longrightarrow O + O \ (\lambda < 2423A) \qquad (2)$$

$$O_3 + O \longrightarrow O_2 + O_2 \qquad (3)$$

$$O_3 + h\nu \longrightarrow O_2 + O \ (\lambda < 11000A) \qquad (4)$$

where h is Planck's constant, ν is the frequency of radiation and λ is the wavelength. More detailed photochemical theories involving neutral constituents such as hydrogen, nitrogen, and their compounds have been studied by various investigators (see, for example, Hesstvedt [8], Dutsch [9], Leovy [10], Shimazaki and Laird [11], and Nicolet [12]).

The theoretical study made by Hunt [13] to investigate the effect of solar eclipse on the stratosphere showed no variation from the normal in the ozone concentration below 45 km altitude. The study was based on the fact that as soon as the solar radiation is blocked from the earth's atmosphere, dissociation of oxygen (Eq. 2) and dissociation of ozone (Eq. 4) no longer take place. The atomic oxygen combines with molecular oxygen to form ozone, and thus an increase in ozone will be observed. As the concentration of atomic oxygen in the lower stratosphere is very small compared to the concentration of molecular oxygen, net increase in the lower stratosphere will be insignificant.

In this experimental study, two soundings were made on 7 July, one with a rocket and the other with a balloon. The balloon observation was made with an electrochemical sonde (MAST) which measured ozone concentration from the surface to about 30 km. These results are shown in Figure 1 and agree very well with one another in the overlap region. Two more rocket ozonesonde observations were made on 10 July, one at 0845 and the other at 0956. The results are plotted in Figure 2. The maximum partial eclipse (92%) occurred at 0958 local time. The uncertainty in these observations is evaluated mainly on two factors, i.e., flow rate and calibration, and is estimated to be of the order of ±15%. The sounding made at 0956 did not show any appreciable change from the earlier sounding above 40 km altitude. The daylight at that latitude at the time of study was more than 21 hours. The solar radiation was never cut off from reaching the atmosphere, and this probably contributed to the lack of increase in ozone concentration in the stratopause region. The increase in ozone around 35 km cannot be due to solar eclipse since not enough atomic oxygen is available to show such a change, but other meteorological factors such as advection may be the cause. This is also evidenced by the sounding made on 11 July (plotted in Figure 3) indicating the daily variability of ozone at these levels. Ozone concentration as measured at various altitudes during this study are given in Table 3.

TEMPERATURE

Temperatures as recorded from the rocket observations are shown in Figures 4 and 5. At 45 km, temperatures recorded on 9 July (1000 LT and 1500 LT), 10 July (0845 LT), and 11 July (1000 LT) are +1, +6, +5, and +6°C, respectively. Because the thermistor was damaged on the 0956 LT sounding, temperatures could not be recorded at the peak of the partial eclipse. It seems that the daily change in temperatures in all the soundings is of the order of 4-5°C near the stratopause level, and the partial solar effect may not be greater than that since there was never a complete cutoff of the solar radiation.

WINDS

The component winds as obtained from these rocket soundings during the period 7-11 July 1972 are shown in Table 2. Generally the winds, especially the north-south component, are found to be low. The effect of partial solar eclipse seems to be negligible on the circulation. For example, on 10 July the east-west component as measured at 46 km for the five soundings is respectively -20, -23, -25, -26, and -17 meters per second (the minus sign indicates a wind blowing from east to west). At the time of maximum partial eclipse, wind speed was -25 meters per second and at the end, -26 meters per second. On 9 July (1000 LT) at 46 km, the east-west component was -20 meters per second, whereas on 11 July (1000 LT), it was -23 meters per second, thus indicating no significant variation during the time of partial solar eclipse. North-south component winds were very light throughout the duration of the experiment. On 10 July, these components as measured at the 46 km level were -2 (0745 LT), -1 (0845 LT), +1 (0956LT), +2 (1100 LT), and +3 (1530 LT) meters per second (the positive sign indicates a wind blowing from south to north). On 9 July at the same level, winds were +1 (1000 LT) and +8 (1500 LT) meters per second, again indicating no appreciable change due to partial solar eclipse.

CONCLUSIONS

The experiment performed during a partial solar eclipse at Poker Flat, Alaska, indicated no detectable variations in ozone concentration, temperature, and wind in the upper stratosphere during the time of the solar eclipse. Observations were made during the week of solar eclipse as well as during and immediately before and after it. The daylight at the site was more than 21 hours at the time of the experiment, and the partial occultation of slightly more than two hours did not produce any observable change in the above parameters in the subpolar stratosphere.

TABLE I

LAUNCH TIMES OF VARIOUS SOUNDINGS

Date	Launch Time (Local Time)	Measured Parameters
7 Jul	1200	Ozone, wind
7 Jul	1500	Ozone (balloon)
9 Jul	1000	Temperature, wind
9 Jul	1500	Temperature, wind
10 Jul	0745	Wind
10 Jul	0845	Ozone, temperature, wind
10 Jul	0956	Ozone, wind
10 Jul	1100	Wind
10 Jul	1530	Wind
11 Jul	1000	Ozone, temperature, wind

TABLE 2

WINDS, MEASURED AT DIFFERENT ALTITUDES

Altitude (km)	7 July (1200) -N+S	7 July (1200) -E+W	9 July (1000) -N+S	9 July (1000) -E+W	9 July (1500) -N+S	9 July (1500) -E+W
35	4	-12	4	-16	1	-11
36	2	-10	4	-16	0	-10
37	4	-13	4	-14	3	-12
38	5	-15	5	-13	4	-14
39	4	-14	8	-13	4	-14
40	3	-15	9	-18	3	-16
41	2	-19	7	-18	3	-18
42	2	-22	3	-21	7	-19
43			-1	-21	16	-17
44			-1	-20	12	-16
45			3	-18	5	-14
46			1	-20	8	-15
47					9	-17
48					7	-18
49					7	-20
50					6	-22

TABLE 2 (con.)

Altitude (km)	10 July (0745) -N+S	-E+W	10 July (0845) -N+S	-E+W	10 July (0956) -N+S	-E+W
35	-3	-14	-5	-16	-2	-18
36	1	-18	-2	-15	1	-18
37	3	-18	0	-15	4	-18
38	4	-16	3	-14	8	-13
39	5	-17	5	-13	10	-13
40	6	-19	5	-13	8	-13
41	5	-19	4	-14	3	-14
42	3	-19	2	-15	1	-15
43	1	-18	2	-17	1	-17
44	-2	-15	3	-19	1	-20
45	-3	-16	0	-18	0	-23
46	-2	-20	-1	-23	1	-25
47	-1	-26	0	-27	4	-26
48	-1	-29	4	-28	5	-25
49	-2	-30	5	-29	6	-25
50	2	-31	1	-31	3	-25

TABLE 2 (con.)

Altitude (km)	10 July (1100) -N+S	-E+W	10 July (1530) -N+S	-E+W	11 July (1000) -N+S	-E+W
35	3	-15	4	-9	2	-14
36	4	-15	2	-10	-2	-13
37	6	-14	2	-10	2	-14
38	6	-13	-1	-10	4	-14
39	7	-11	-1	-12	6	-12
40	4	-13	0	-15	2	-14
41	1	-15	1	-18	4	-19
42	1	-18	4	-16	3	-20
43	2	-22	5	-16	3	-22
44	0	-23	5	-19	4	-25
45	0	-25	4	-18	4	-23
46	2	-26	3	-17	1	-23
47	6	-24	2	-16	4	-25
48	7	-24	2	-16		
49	5	-26				

TABLE 3

OZONE CONCENTRATION (MOLECULES/M^3) AT DIFFERENT ALTITUDES

Altitude (km)	7 July 1200	10 July 0845	10 July 0956	11 July 1000
35	8.0×10^{17}	7.6×10^{17}	10.3×10^{17}	15.6×10^{17}
37	6.2	5.4	8.2	10.5
39	4.2	4.2	5.2	6.5
41	2.5	2.9	3.5	4.4
43	1.0	1.9	2.0	2.6
45	---	1.2	1.1	1.4
47	---	7.0×10^{16}	5.8×10^{16}	7.1×10^{16}
48	---	5.0	3.6	5.0

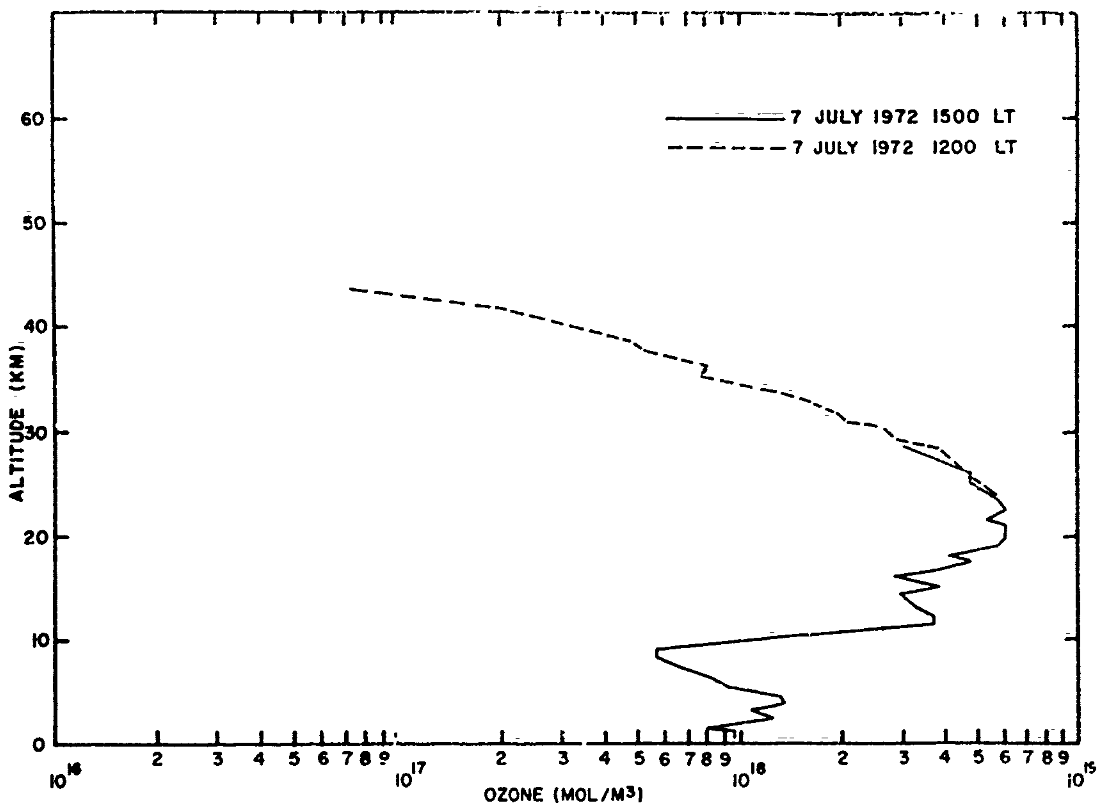

Figure 1. Ozone Concentration over Poker Flat, Alaska on 7 July 1972.

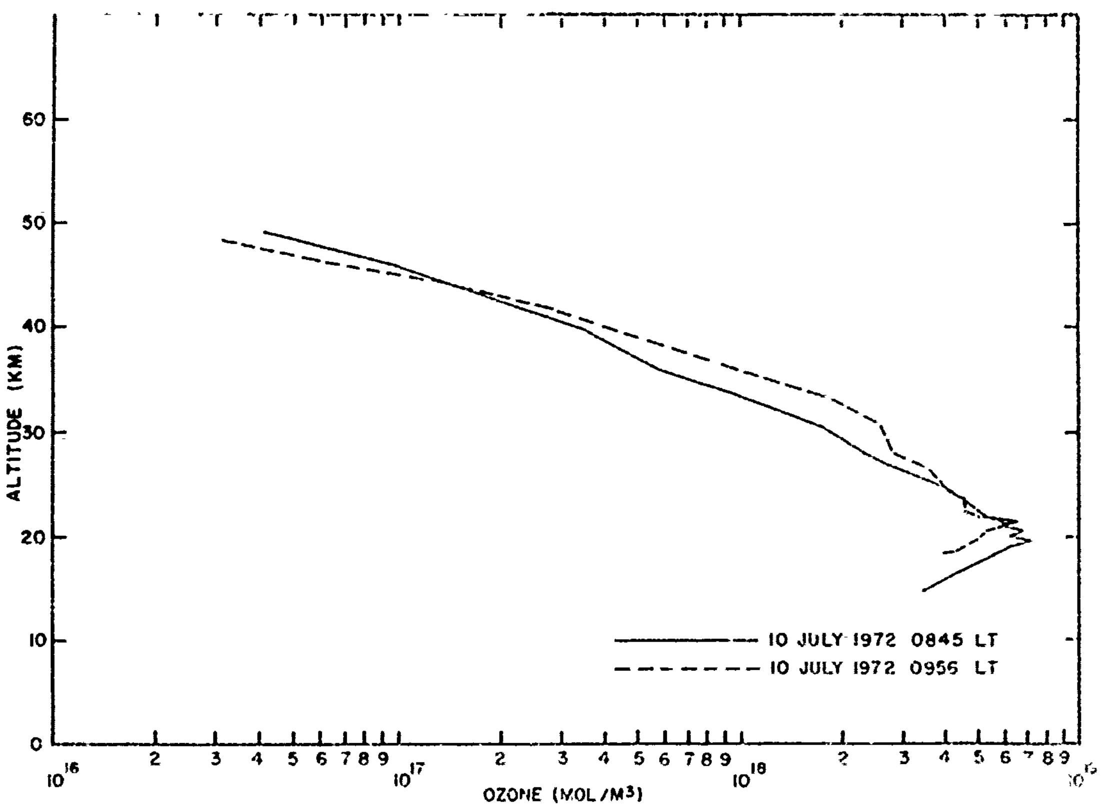

Figure 2. Ozone Concentration over Poker Flat, Alaska on 10 July 1972, 0845 LT.

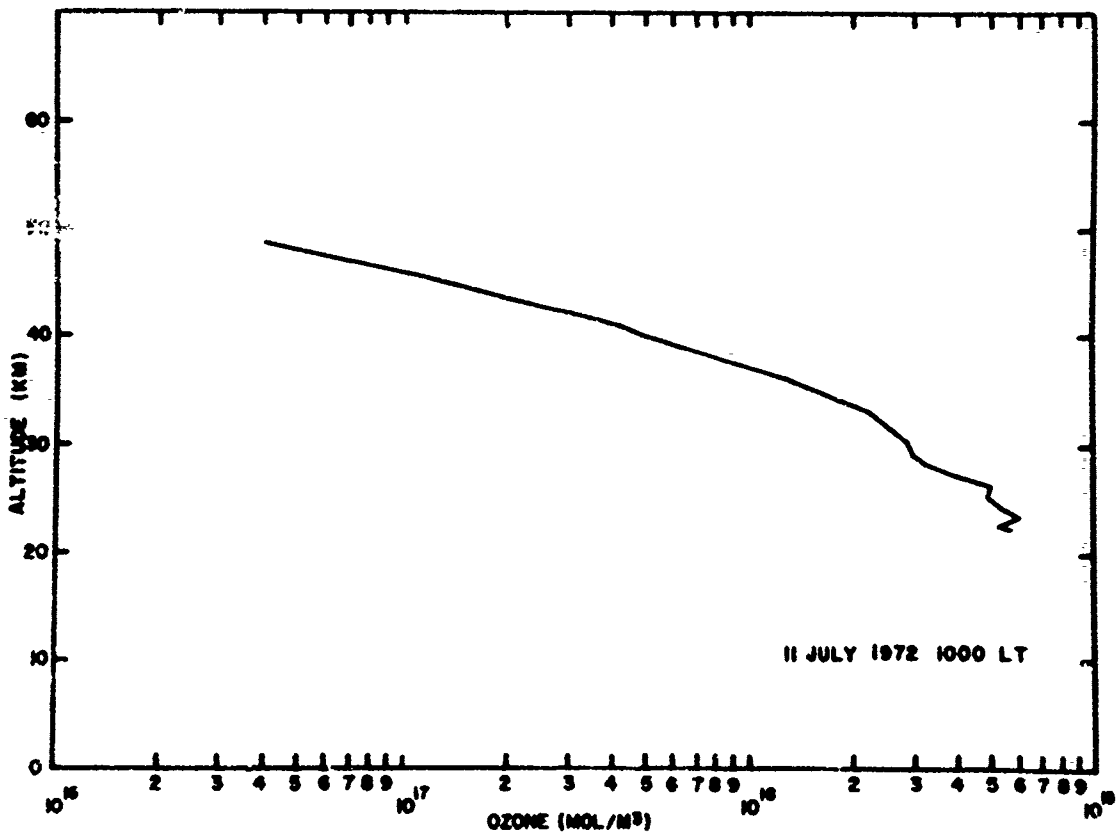

Figure 3. Ozone Concentration over Poker Flat, Alaska on 11 July 1972.

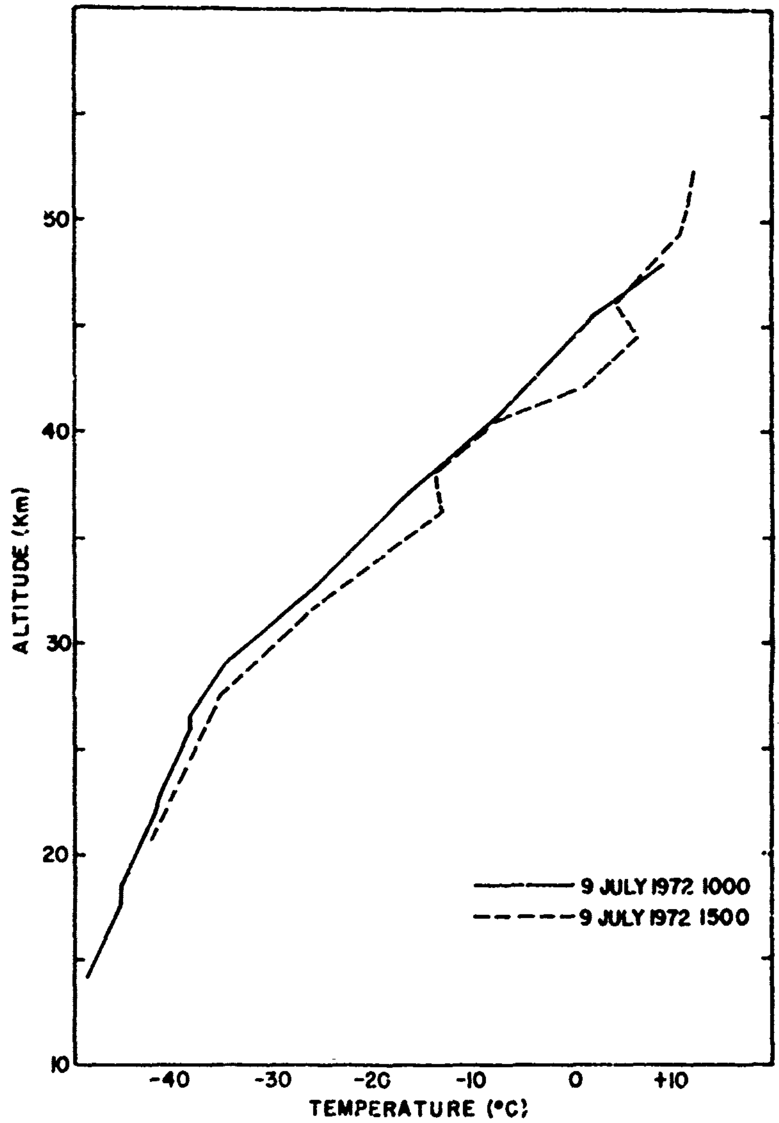

Figure 4. Temperatures as Obtained on 9 July 1972 over Poker Flat, Alaska.

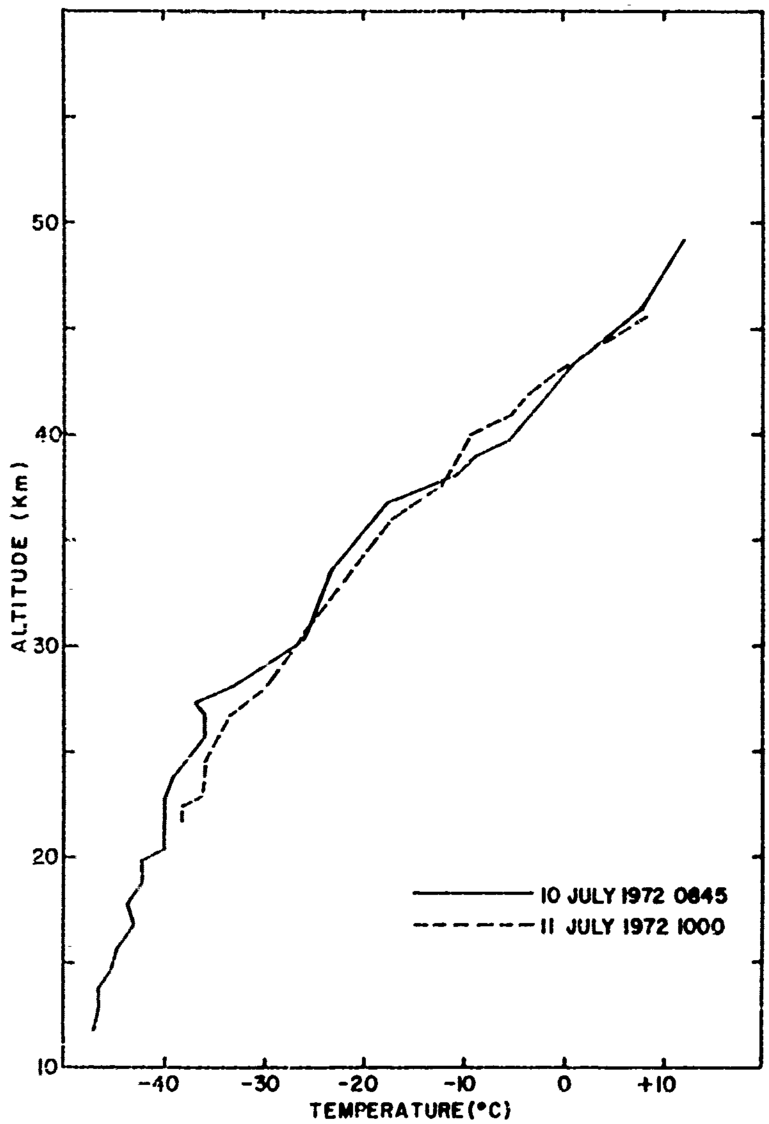

Figure 5. Temperatures as Obtained on 10 July and 11 July 1972 over Poker Flat, Alaska.

LITERATURE CITED

1. Randhawa, J. S., 1968, "Mesospheric Ozone Measurements During a Solar Eclipse," J. Geophys. Res., 73, 493.

2. Henry, R. M., and R. S. Quiroz, 1970, "Preliminary Results from a Meteorological Rocket Experiment," Nature, 226, 1108.

3. Beyers, N. J., and B. T. Miers, 1965, "Diurnal Temperature Change in the Atmosphere Between 30 and 60 Kilometers Over White Sands Missile Range, New Mex'co," J. Atmo. Sci., 22, 262

4. Miers, B. T., 1965, "Wind Oscillations Between 30 and 60 Kilometers Over White Sands Missile Range, New Mexico," J. Atmo. Sci., 282.

5. Beyers, N. J., B. T. Miers, and R. J. Reed, 1966, "Diurnal Tidal Motions Near the Stratopause during 48 Hours at White Sands Missile Range," J. Atmo. Sci., 23, 325.

6. Randhawa, J. S., 1967, "Ozonesonde for Rocketflight," Nature, 213, 53.

7. Brewer, A. W., and J. R. Milford, 1960, "The Oxford-Kew Ozonesonde," Proc. Roy. Soc. A256, 470.

8. Hesstvedt, E., 1968, "On the Photochemistry of Ozone in the Ozone Layer," Geof. Publ., 27, No. 5.

9. Dutsch, H. U., 1968, "The Photochemistry of Stratospheric Ozone," Quart. J. Roy. Met. Soc., 94, 483.

10. Leovy, C B., 1969, "Atmospheric Ozone: An Analytic Model for Photochemistry in the Presence of Water Vapor," J. Geosphy. Res., 74, 417.

11. Shimazaki, T., and A. R. Laird, 1970, "A Model Calculation of the Dirunal Variations in Minor Neutral Constituents in the Mesosphere and Lower Thermosphere Including Transport Effects," J. Geophys. Res., 75, 3221.

12. Nicolet, M., 1972, "Aeronomic Chemistry of the Stratosphere," Planet Space Sci., 20, 1671.

13. Hunt, B. G., 1965, "A Theoretical Study of the Changes Occurring in the Ozonesphere During a Total Eclipse of the Sun," Tellus, 17, 516.

ATMOSPHERIC SCIENCES RESEARCH PAPERS

1. Dickson, David H., and James R. Oden, Fog Dissipation Techniques for Emergency Use, January 1972, ECOM-5420.
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60. Randhawa, J. S., "An Investigation of Solar Eclipse Effect on the Subpolar Stratosphere," ECOM-5507, September 1973.